IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of **REINER KOPPE ET AL** Atty. Docket **DE000137**

Serial No. **10/082,865** Group Art Unit: **2855**

Filed: **OCTOBER 19, 2001** Examiner: **ERIC SCOTT McCALL**

TOMOSYNTHESIS IN A LIMITED ANGULAR RANGE

Commissioner for Patents, Alexandria, VA 22313-1450

Sir:

Enclosed is an original plus two copies of an Appeal Brief in the above-identified patent application.

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Respectfully submitted,

By _____
John Vodopia, Reg. 36,299
Attorney
(914) 333-9627

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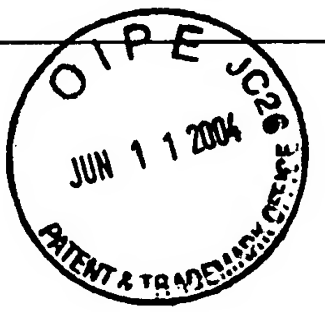

In re Application of:

Reiner KOPPE et al.

Serial No.: 10/082,865

Filed: October 19, 2001

For: Tomosynthesis in a limited angular range

Examiner: McCall, Eric Scott
Group Art: 2855

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Appellants' Brief On Appeal Under 37 CFR 1.192

This is an Appeal from decision by the US Patent Office, dated December 8, 2003, finally rejecting claims 1-16, the pending claims; a Notice of Appeal was mailed in this case on March 8, 2004.

I. Real Party In Interest

The above application is assigned, in its entirety, to Koninklijke Philips Electronics, NV, a corporation organized under the laws of the Netherlands, with offices at Groenwoudseweg 1, Eindhoven, The Netherlands.

II. Related Appeals and Interferences

Appellants are not aware of any co-pending appeal or interference which will directly affect or be directly affected by or have any bearing on the board's decision in the pending appeal.

III. Status of Claims

Claims 1-16 are pending in the application. Claims 1, 2, 4, 7, 8, 13 and 14 were rejected under 35 USC 102(b) as being anticipated by Pct Document WO 00/24314, commonly owned by Koninklijke Philips Electronics, NV ("the Philips prior art"), and claims 3, 5, 9-12, 15 and 16 were rejected under 35 USC 103(a) as unpatentable over the Philips prior art.

IV. Status of Amendments

No amendments were filed subsequent to the December 8, 2003, final Office Action.

V. Summary of the Invention

Th present inventions, as set forth in independent method claim 1, independent x-ray device claim 13, and independent method claim 16, are directed to forming an x-ray layer image of adequate image quality in a single plane, or in mutually parallel planes, directly from x-ray projection images, while using fewer x-ray projection images, less angular range or a shorter period of time than those devices and methods of the prior art for forming x-ray layer images.

The inventions are based on the premise that formation of a layer image in a single plane or in parallel planes does not necessitate displacement of the x-ray source and the x-ray detector through at least 180° around the object being examined. That is, the inventions as claimed teach that the acquisition of x-ray projection images from an angular range of less than 180° suffices to form an x-ray layer image of adequate image quality. Those skilled in the art understand that artefacts are found to occur only to a limited extent in an angular range of less than 180°, and when within that range, may be ignored during clinical applications.

The x-ray layer images formed in accordance with the claimed inventions are calculated directly from the x-ray projection images; as opposed to prior art methods (such as the Philips prior art), where x-ray layer images are calculated from an intermediate 3D data set determined from the x-ray projection images. Thus, in accordance with the inventions as claimed, x-ray layer images can be formed in parallel layers in a simple and fast manner, without the need for the intermediate 3-D data set. The angular displacement range to be covered by the inventions as claimed is smaller than those displacement ranges known to be utilized in the prior art.

VI. Issues

A) Are Claims 1, 2, 4, 7, 8, 13 and 14 patentable under 35 USC 102(b) in view of the Philips prior art?

B) Are Claims 3, 5, 6, 9-12, 15 and 16 patentable under 35 USC 103(a) in view of the Philips prior art?

VII. Grouping of Claims

For the purposes of issues A & B, above, dependent claims 2-12, 14 and 15, which depend respectively from independent claims 1 and 13, shall stand or fall together controlled by the status of independent claims 1 and 13; claim 16 has no dependencies.

VIII. Argument

Applicants' independent claims:

Applicants' independent claim 1 sets forth a method of forming an X-ray layer image of an object with an X-ray device having an X-ray source and an X-ray detector, including steps of displacing the X-ray source and the X-ray detector in an angular range around the object in order to acquire X-ray projection images and forming an X-ray layer image directly from the X-ray projection images without creating an intermediary three-dimensional data set, the formed X-ray layer image being situated in a plane which extends essentially perpendicularly to a bisector of the angular range, wherein the angular range of displacement is less than 180°.

Applicants independent claim 13 sets forth an X-ray device, including an X-ray source and an X-ray detector, each situated on an opposite side of an object being examined for the acquisition of X-ray projection images of the object. At least one of the X-ray source and the X-ray detector are movable so that X-ray projection images are acquired in an angular range around the object; an image processing unit for forming an X-ray layer image from the X-ray projection images; and a control unit for controlling the X-ray device. Only X-ray projection images in an angular range of less than 180° are acquired in order to form the X-ray layer image. The image processing unit forms the X-ray layer image directly from the X-ray projection images without creating an intermediary three-dimensional data set. The X-ray layer image is situated in a plane which extends essentially perpendicularly to a bisector of the angular range.

Applicants' independent claim 16 sets forth a method of forming an X-ray layer image of an object with an X-ray device having an X-ray source and an X-ray detector. The method includes displacing the X-ray source and the X-ray detector over a less than 180° angular range around an object being examined in order to acquire less than 100 X-ray projection images; and forming at least one X-ray layer image directly from the less than 100 X-ray projection images without creating an intermediary three-dimensional data set, the formed X-ray layer image being situated in a plane which extends essentially perpendicularly to a bisector of the angular range.

IX Discussion of Claims

Philips prior art:

The Philips prior art describes an X-ray device for performing tomography on a patient. As seen in FIG. 5 of the Philips prior art, the X-ray device has a movable X-ray source 6 on one side of a patient and a corresponding movable X-ray detector 5 on the other side of the patient. The X-ray source 6 moves through an angular range (with X-ray detector 5 moving through a reciprocal angular range on the other side of the patient) in order to realize a tomographic image of a layer within the patient.

During formation of the tomographic image, the x-ray source is pivoted about the pivot shaft and at the same time the receiving plate is displaced relative to the patient by means of a single guide system (where the prior art showed such systems requiring two (2) guide systems). The pivot shaft is journaled in a slide displaceable relative the frame by way of a guide system, the slide also accommodating the receiving plate. A controller controls the pivoting motion of the x-ray source and the displacement of the slide in such a manner that a tomographic image may be formed in a desired plane. As a result of the displacement of x-ray source 6 and receiving plate 5 relative to one another, a focused image is obtained only of plane 27 of Fig. 5.

As set forth in the Philips' prior art, when use is made of a C-arm device, as in a preferred embodiment, the bisector thus corresponds to the central pivot position of the x-ray source when it is pivoted from side to side. The bisector is the center of the overall angle covering the angular range. Moreover, the x-ray layers in accordance with the Philips prior art inventions are calculated directly from the x-ray projection images, as applied to prior art methods where they are calculated from a 3-D data set determined from the x-ray projection images. Thus in accordance with the Philips' prior art inventions, x-ray layer images can be formed in parallel layers in a simple and fast

manner, because the angular displacement range to be covered is smaller than the prior art methods. And in a preferred embodiment of the Philips prior art method, the total angular range is 90 to 180 degrees.

A complete 3-D data set of the region of interest (ROI) is first acquired in order to calculate and reproduce one or more x-ray layer images therefrom by means of a suitable reconstruction method as understood by those skilled in the art). For acquisition of a complete 3-D data set, however, it is necessary to acquire x-ray projection images from a minimum range so as to satisfy the "condition of completeness" (a phrase understood by those of skill in the art at the time of the present inventions as claimed). To this end, before the present inventions as claimed, it was necessary that at least to acquire x-ray projection images using an angular range of at least 180 degrees, which means the x-ray source and detector are rotated along a trajectory in the form of a ½ circle, and the x-ray projection images are then acquired from different angular positions in order to extract data for a 3-D data set therefrom.

Rejections of Claims

The Examiner rejected independent Claims 1 and 13, as well as Claims 2, 4, 7, 8, and 14 dependent thereon, under 35 USC §102(b) as anticipated by the Philips prior art. The Examiner rejected dependent Claims 3, 5, 6, 9-12 and 16 under 35 U.S.C. §103(a) as unpatentable over the Philips prior art. Applicants submit that for purposes of this appeal, that the patentability of each of the rejected claims will stand or fall in view of the patentability of independent claims 1 and 13 under 102(b) in view of Philips prior art, and independent claim 16 under 35 USC 103(a) in view of the Philips prior art.

Applicants' present application describes how prior art systems required that the X-ray source go through an angular range of at least a 180° in order to generate a tomographic image, typically requiring more than 100 projection images to generate one tomographic image. An intermediary three-dimensional data set was required in prior art systems in order to form the final tomographic image. The x-ray source and detector move long circular trajectories, where it was assumed that a complete data set is necessary for the reconstruction of high quality layer images. See page 1 of applicants' Specification.

In the final Office Action, the Examiner states that the Philips prior art focuses on a description of the physical device, and provides no discussion of the appropriate angular range of

the X-ray source 6 and X-ray detector 5, or the amount of projection images which must be taken in order to form a single tomographic image, or the process by which the final tomographic image is formed. The Examiner asserts that because the cited Philips prior art does not explicitly state or clearly suggest that an intermediary 3-D data set is required to form a final tomographic image, Section 102(b) establishes that there is no "prior art" (as distinguished from the Philips prior art) which states or clearly suggests that an intermediary 3-D data set is required, such that the Philips prior art, based on the Examiner's logic, teaches what the present application claims.

Applicants' Position

102(b)

It is applicants' position that while the Philips prior art does not expressly reiterate the level of skill in the art of x-ray layer images (planar images), the state of the art at the time of invention required an intermediary 3-D data set to form the final tomographic or projection image. That is, applicants respectfully assert that the skilled artisan would understand that the layer image reconstruction as taught by the Philips prior art requires that the x-ray layer image be calculated from a 3-D data set determined by x-ray projection images, at the date of applicants' inventions as claimed.

In particular, applicants' inventions as set forth in independent Claims 1, 13 and 16, do ***not*** require an intermediary three-dimensional data set to form the final tomographic image, but rather generate the final tomographic image directly from the projection images themselves. That is, X-ray layer images are calculated directly from x-ray projection images, as distinguished from the convention method requiring the calculation of the layer image from a 3-D data set determined from the x-ray projection image. See page 3 of applicants' Specification. Those projection images are taken in an angular range of less than 180°.

The law of anticipation is clear that for a prior art reference to anticipate a claim, the prior art reference must disclose each and every element of that claim with sufficient clarity to prove its existence in the prior art. Those elements must either be inherent or disclosed expressly and must be arranged as in the claim. Glaverbel SA v. Northlake Mkt'g & Supp., Inc., 33USPQ2d 1496 (Fed. Cir. 1995); Constant v. Advanced Micro-Devices, Inc., 7 USPQ2d 1057 (Fed. Cir. 1988); Richardson v. Suzuki Motor Co., 9 USPQ2d 1913 (Fed. Cir. 1989). For anticipation, there must be no difference between the claimed invention and the reference disclosure, as viewed by a person of

ordinary skill in the field of the invention. Scripps Clinic & Res. Found. V. Genentech, Inc., 18 USPQ2d 1001 (Fed. Cir. 1991). The absence from the reference of any claimed element negates anticipation. Kloster Speedsteel AB v. Crucible Inc., 230 USPQ 81 (Fed. Cir. 1986).

While the Examiner at page 4 of the final Office Action asserts that the Philips prior art teaches forming an x-ray layer image directly from the x-ray projection images (page 4, lines 10-15) without creating an intermediary 3-D data set, applicant respectfully disagrees. Lines 1-15 of the Philips prior art, and its Fig. 5, refer to a point M in a plane 27 for which a tomographic image is to be formed. By displacement, a focused image is obtained only of plane 27. The Philips prior art, therefore, does not teach or suggest forming an x-ray layer image directly from the x-ray projection images without creating an intermediary 3-D data set. X-ray layer images in accordance with the present inventions, as claimed, are calculated directly from the x-ray projection images, as opposed to prior art methods where they are calculated from a 3-D data set determined from the x-ray projection images.

Applicant's inventions, as claimed, require the limitation that the x-ray layer images obtained be calculated directly from the x-ray projection images, and do not require an intermediate calculation of a 3-D data set, as known to those of skill in the art. The law of inherency states that anticipation requires that every element of the claims appear in a single reference accommodates situations where the common knowledge of technologists is not recorded in the reference. Continental Can Co. USA v. Monsanto Co., 20 USPQ2d 1746 (Fed. Cir. 1991). Regardless of whether the Philips prior art teaches the state of the art at the time of the invention, i.e., an intermediate 3-D data set, it nevertheless does not anticipate applicant's claims because it is missing the element requiring forming an x-ray layer image directly from the x-ray projection images without creating an intermediary 3-D data set. Hence, the Philips prior art cannot anticipate applicant's independent calims.

Applicants respectfully assert, therefore, that independent claims 1 and 13, dependent claims 2, 4, 7, 8, and claim 14, which depend therefrom, are not anticipated by the Philips prior art, and request withdrawal of the same claim rejections in view of same under 35 USC 102(b).

103(a)

In the final Office Action, claims 3, 5, 6, 9-12, 15 and 16 were rejected under 35 USC 103(a) as unpatentable over the Philips prior art.

In response, applicants respectfully assert that claims 3, 5, 6, 9-12, 15 and 16, are not obvious under 35 USC 103 (a), because the Philips prior art is Section 102(e) art pursuant to 35 USC 103(c), the reference is excludable. That is, Section 103(c) states that subject matter developed by another person, which qualifies as prior art only under one or more of subsections (e), (f), and (g) of section 102 shall not preclude patentability under this section where the subject matter and the claimed invention were, at the time of the invention was made, owned by the same person or subject to an obligation of assignment to the same person.

Applicants' present application was filed October 19, 2001, and assigned to the common owner, Koninklijke Philips Electronics NV, by assignment recorded May 28, 2002, at reel 012931, and frames 0147-49. The Philips Prior art, WO 00/24314, is owned by Koninklijke Philips Electronic, NV, with an international filing date of September 29, 1999. The Philips prior art and the rights to applicants' inventions as claimed were commonly owned on October 19, 2001. Hence, applicants respectfully assert that the rejections of claims 3, 5, 6, 9-12, 15 and 16 are now moot with the Philips prior art excluded under 35 USC 103(c), and request withdrawal of the rejections to said claims under 103 (c).

Conclusion:

It is respectfully submitted that all of the rejections set forth in the final office action are erroneous, and that all of the claims are allowable. Wherefore, it is further respectfully requested that Examiner McCall's decision finally rejecting claims 1-16 be reversed in all respects.

Respectfully submitted,

Dated: June 8, 2004

By _____

John F. Vodopia (36,299)
Attorney for Applicants
914 333 9627

Listing of Claims:

1. A method of forming an X-ray layer image of an object with an X-ray device having an X-ray source and an X-ray detector, comprising the steps of:

displacing the X-ray source and the X-ray detector in an angular range around the object in order to acquire X-ray projection images; and

forming an X-ray layer image directly from the X-ray projection images without creating an intermediary three-dimensional data set, the formed X-ray layer image being situated in a plane which extends essentially perpendicularly to a bisector of the angular range;

wherein the angular range of displacement is less than 180°.

2. The method as claimed in claim 1, wherein the position of the angular range relative to the object can be changed.

3. The method as claimed in claim 1, wherein the angular range lies between 90° and 180°.

4. The method as claimed in claim 1, wherein the angular range is less than 90°.

5. The method as claimed in claim 1, wherein 100 or less X-ray projection images are acquired in order to form the X-ray layer image.

6. The method as claimed in claim 1, wherein no more than about 80 X-ray projection images are acquired in order to form the X-ray layer image.

7. The method as claimed in claim 1, wherein a plurality of X-ray layer images of the object which extend essentially parallel to one another are formed from the acquired X-ray projection images.

8. The method as claimed in claim 1, wherein the X-ray projection images are acquired

by means of a C-arm X-ray device.

9. The method as claimed in claim 1, wherein a plurality of X-ray layer images of neighboring thin layers are combined in order to form an X-ray layer image of a thicker slice.

10. The method as claimed in claim 1, wherein the X-ray source and the X-ray detector are displaced along a circular trajectory around the object in order to acquire X-ray projection images.

11. The method as claimed in claim 1, wherein the X-ray source and the X-ray detector are displaced in opposite directions in parallel planes in order to acquire X-ray projection images.

12. The method as claimed in claim 11, wherein only one of the X-ray source or the X-ray detector is displaced in order to acquire X-ray projection images.

13. An X-ray device comprising:

an X-ray source and an X-ray detector, each situated on an opposite side of an object being examined for the acquisition of X-ray projection images of the object, wherein at least one of the X-ray source and the X-ray detector are movable so that X-ray projection images are acquired in an angular range around the object;

an image processing unit for forming an X-ray layer image from the X-ray projection images; and

a control unit for controlling the X-ray device;

wherein only X-ray projection images in an angular range of less than 180° are acquired in order to form the X-ray layer image; and

wherein the image processing unit forms the X-ray layer image directly from the X-ray projection images without creating an intermediary three-dimensional data set, where the formed X-ray layer image is situated in a plane which extends essentially perpendicularly to a bisector of the angular range.

14. The X-ray device as claimed in claim 13, wherein the X-ray device includes a C-arm system.

15. The method as claimed in claim 1, wherein between about 60 and about 80 X-ray projection images are acquired in order to form the X-ray layer image.

16. A method of forming an X-ray layer image of an object with an X-ray device having an X-ray source and an X-ray detector, comprising the steps of:

displacing the X-ray source and the X-ray detector over a less than 180° angular range around an object being examined in order to acquire less than 100 X-ray projection images; and

forming at least one X-ray layer image directly from the less than 100 X-ray projection images without creating an intermediary three-dimensional data set, the formed X-ray layer image being situated in a plane which extends essentially perpendicularly to a bisector of the angular range.